"On the Laws governing Electric Discharges in Gases at Low Pressures." By W. R. CARR, B.A., University of Toronto. Communicated by Professor J. J. THOMSON, F.R.S. Received February 11,—Read March 5, 1903.

(Abstract.)

The experiments described in this paper were undertaken with the object of determining the potential difference required to produce discharge in a number of gases over a wide range of pressures, and especially of ascertaining if the law enunciated by Paschen* was generally applicable, provided the electric field in which the discharge took place was uniform.

The paper is divided into the following sections :—

(1.) Introduction.
(2.) Description of apparatus.
(3.) Experiments in air.
(4.) Experiments in hydrogen.
(5.) Experiments in carbon dioxide.
(6.) Spark potentials with different electrodes.
(7.) Minimum spark potentials.
(8.) Connection between spark lengths and spark potentials.
(9.) Minimum spark potentials in different gases.
(10.) Summary of results.

Paschen's experiments showed that when a given potential difference was applied to two spherical electrodes whose distance apart could be varied, the maximum pressure at which discharge occurred in a gas varied inversely with the distance between the electrodes. The range of pressures covered by his experiments did not extend below 2 cm. of mercury.

While Paschen has shown that as the pressure of a gas diminishes the difference of potential necessary to produce discharge between electrodes in a gas, a fixed distance apart, also diminishes, Peace† has shown that a critical pressure is finally reached when the spark potential reaches a minimum value, and that below this critical pressure the potential difference required to produce discharge rapidly increases as the pressure is lowered. Peace's experiments were conducted with air, and his electrodes consisted of a pair of large parallel plates supported in the gas. The values of the spark potentials recorded by him led to the conclusion that Paschen's law did not hold for electric discharges at and below the critical pressure.

In this paper it is shown that with the apparatus used by Peace, the

* Paschen, 'Wied. Ann.,' vol. 37, 1889, p. 79.
† Peace, 'Roy. Soc. Proc.,' vol. 52, p. 99.

discharges at low pressures in all probability did not take place along the shortest path between the plates, and it is inferred that the failure of his numbers to establish the applicability of Paschen's law at all pressures is due to his having always taken this shortest distance between the electrodes as a measure of the spark length.

In the present paper an account is given of an investigation on the potential difference necessary to produce discharges in a gas with a form of apparatus which ensured the passage of the discharge in a uniform electric field at all pressures. With this apparatus the spark potentials were determined in air, hydrogen, and carbon dioxide, for different distances between the electrodes, over a range extending considerably above and below the critical pressures. Electrodes of brass, iron, zinc, and aluminium, of the same size, were in turn used in the apparatus, but the readings obtained showed that the spark potentials were not influenced at any pressure by the size of the electrodes, provided the discharge took place in a uniform field.

The result of the investigation not only confirmed the truth of the law enunciated by Paschen for discharges in a gas at high pressures, but also demonstrated the applicability of the same law to the critical and to lower pressures. This law is summarised in the statement "that with a given applied potential difference, electric discharge in a uniform field in any gas is dependent solely on the constancy of the quantity of matter per unit cross-section between the electrodes."

It is shown that a general application of Paschen's law demands that the minimum spark potential must be a physical constant for each gas. A special set of observations gave the following values of this quantity for a number of simple and compound gases.

Gas.	Minimum spark potentials in volts.
H_2	278
O_2	455
H_2S	414
CO_2	419
N_2O	420
SO_2	457
C_2H_2	467

Adopting Strutt's value of 251 volts for nitrogen, the conclusion is drawn that the minimum spark potential is a property of the atom rather than the molecule of a gas, and it is shown that if H', N', O', etc., represent the spark potential constants in volts, corresponding to atoms of the gases H_2, N_2, O_2, etc., respectively, the minimum spark potential for any compound gas whose formula is $H_xN_yO_z$, etc., will be given by $xH' + yN' + zO' +$ etc. volts. It is pointed out that oxygen forms an exception to the general application of this law.

The latter part of the paper deals with the extension of Paschen's law to spark lengths much shorter than those actually used in the experiments, and evidence is adduced in support of the conclusion that the law is applicable for discharges in a uniform field in any gas, as long as the spark length is greater than the diameter of the sphere of molecular action.

"On the Optical Activity of Hæmoglobin and Globin." By ARTHUR GAMGEE, M.D., F.R.S., Emeritus Professor of Physiology in the Owens College, Victoria University, and A. CROFT HILL, M.A., M.B., late George Henry Lewes Student in Physiology. Received January 31,—Read February 12, 1903.

Introductory Observations.

All observations hitherto published concerning the optical activity of the albuminous substances have led to the conclusion that the bodies thus designated, whether derived from the vegetable or the animal kingdoms, without a single exception, deviate the plane of polarisation to the left, no case having hitherto been known either of a dextrogyrous, a racemic, or an otherwise inactive albuminous substance.*

There is one group of albuminous substances which, notwithstanding the fact that it includes bodies of paramount physiological and chemical interest, has hitherto been completely neglected, in so far as the investigation of the optical activity of its members is concerned. The group to which we refer is that which has been designated by German writers the group of the "Proteïde." This group comprises those complex albuminous substances which can, with greater or less ease, be split up into, or which yield as products of decomposition, on the one hand, albuminous bodies, and on the other, such bodies as colouring matters, or nucleins and nucleinic acids and the purin-bases which result from the decomposition of the latter. The best

* Whilst this paper was being printed, it has come to our knowledge that the late Professor Alexander Schmidt, of Dorpat, described under the name of Cytoglobin, what was certainly a mixture of impure nucleoproteids which he separated from the soluble constituents of many animal cells. He definitely recognised the dextrorotatory properties of this product. For information on A. Schmidt's work, the reader is referred to the "Supplementary Bibliographical Note" at the end of the paper by Gamgee and W. Jones "On the Nucleoproteids of the Pancreas' Thymus, and Suprarenal Gland, with especial reference to their Optical Activity." *Infra*, p. 385.—*March* 5.